Appendix H

Flooding Assessment

(SLR, 2015a)



Flooding Assessment

Euroley Poultry Production Complex

Euroley, NSW

Report Number 610.14072

20 May 2015

ProTen Holdings Pty Ltd

Version: Revision 0

Flooding Assessment

Euroley Poultry Production Complex

Euroley, NSW

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Reference	Status	Date	Prepared	Checked	Authorised
610.14072	Revision 0	20 May 2015	Will Legg	Andrew Behrens	Nicole Armit

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1 INTRODUCTION

This Flooding Assessment has been prepared to inform the Environmental Impact Statement (EIS) to support an application by ProTen Holdings Pty Limited (ProTen) seeking development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to develop an intensive poultry broiler production farm known as the Euroley Poultry Production Complex, within a rural property near Euroley in south-western New South Wales (NSW) (the Site).

The Euroley Poultry Production Complex comprises the development of five poultry production units (PPU), where broiler birds will be grown for human consumption.

The objective of the flooding assessment was to determine the flood risk at the Site to inform mitigation measures for building design and to identify safe refuge areas within the Site. Due to the lack of topographical information outside the Site boundary, safe access and egress from the Site was unable to be quantitatively assessed.

1.1 Scope of Work

The following scope of work was undertaken:

- Site walkover;
- Hydraulic calculations of flood flows from the Murrumbidgee floodplain which could potentially impact on the Site;
- Hydrological modelling of local overland flows;
- One dimensional hydraulic modelling of local overland flood flows; and
- Preparation of flood maps and reporting.

1.2 Limitations

The assessment was undertaken with consideration to the project constraints and the following limitations:

- No detailed topographical data for land surrounding the Site;
- No topographical data at the eastern and southern fringes of the Site;
- No flow or velocity data for the Murrumbidgee River or Yanco Creek flooding; and
- No detailed historical flood flow or level data.

Due to the limitations above, a conservative, but simplified approach was adopted for assessing flooding across the Site as detailed in the Sections 3 and 4.

2 SITE WALKOVER

An experienced SLR hydrologist undertook an inspection of the Site and surrounding catchment on the 12th May 2015.

The Site topography was very flat, with short grass across most of the Site and sporadic trees and patches of longer grasses within topographical depressions. There were no natural hydrological features running across the Site however some shallow drainage ditches running around some of the field boundaries were observed. Local overland flow within large to extreme rainfall events is likely to flow towards lower lying areas within two topographical depressions running east to west across the Site. It is likely that these topographical depressions would act as runoff storage areas during frequent storm events and ephemeral flow paths during large to extreme flood events. A large pool was observed at one location in the topographical depression feature running through the centre of the Site.

The catchment upstream (east) of the Site was similar to the Site, again very flat, primarily vegetated with short grass with the exception of topographical depressions where sporadic trees were observed. Similarly no channel type hydrological features were observed within the fields (except drainage ditches at some of the field boundaries) between Dry Lake (approximately 4.3 km east of the Site) and the Site.

Due to the very flat grade across the Site and surrounding catchment and the lack of any deep channel type features, it is considered that floodwater is likely to be widespread and slow moving during large to extreme rainfall events.

A selection of photographs taken during the Site visit and a photo plan are provided in **Appendix A**.

3 MAIN STREAM FLOODING

Narrandera Shire Council's existing flood mapping developed as part of the Narrandera Flood Study (SKM, 2000) terminates at Yanco weir, therefore flood extents for Murrumbidgee River and Yanco Creek have not been defined adjacent to the Site.

A review of the Narrandera Flood Study is currently being undertaken by Lyall & Associates. Council provided flood mapping developed as part of this review. As the flood model boundary does not extend to the development Site; the mapped flood extents cannot be entirely relied upon for assessing flood conditions within the development Site.

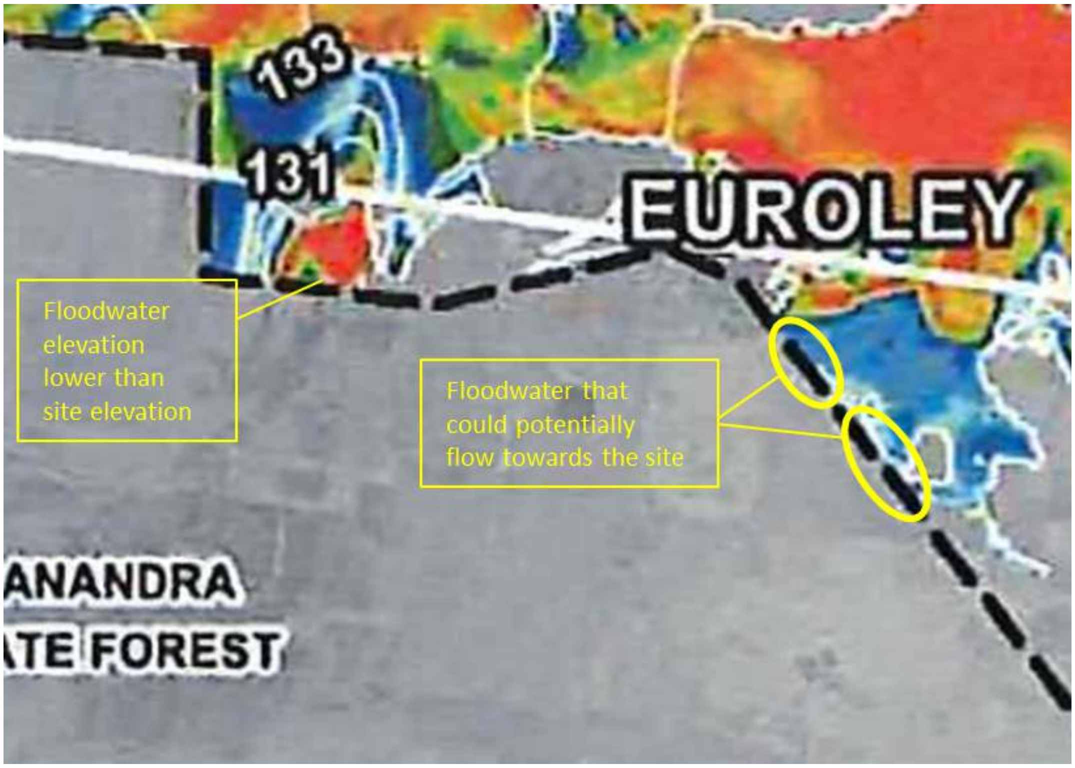
The 100 year ARI flood extent and historical flooding anecdotal evidence (aerial photograph of the 1974 event) indicates that the Site is unlikely to be flooded as a result of the Murrumbidgee River or Yanco Creek overtopping its banks in events up to and including the 100 year ARI event. During an extreme flood event, such as the Probable Maximum Flood (PMF), floodwater could potentially encroach onto the development Site. However, this is considered unlikely to occur due to the distance of the development Site from the floodplain and local topography.

The flood risk from two zones where floodwater is shown to extend to the model boundary and could potentially progress towards the Site is assessed below.

3.1 Murrumbidgee Floodplain at Euroley

A potential overland flow route was identified between floodwater at the model boundary near Euroley (as shown in **Figure 1** below) and the Site.

Figure 1 Potential flood risk from Murrumbidgee floodplain PMF extent



Although floodwater is likely being stored in a topographical depression (rather than flowing) at this location, for the purposes of this conservative assessment, floodwater was assumed to be flowing overland at the model boundary.

The flood flow rate towards the Site was estimated using Mannings equation and the Extreme Flood Map (Lyall & Associates, 2015). The following assumptions were applied:

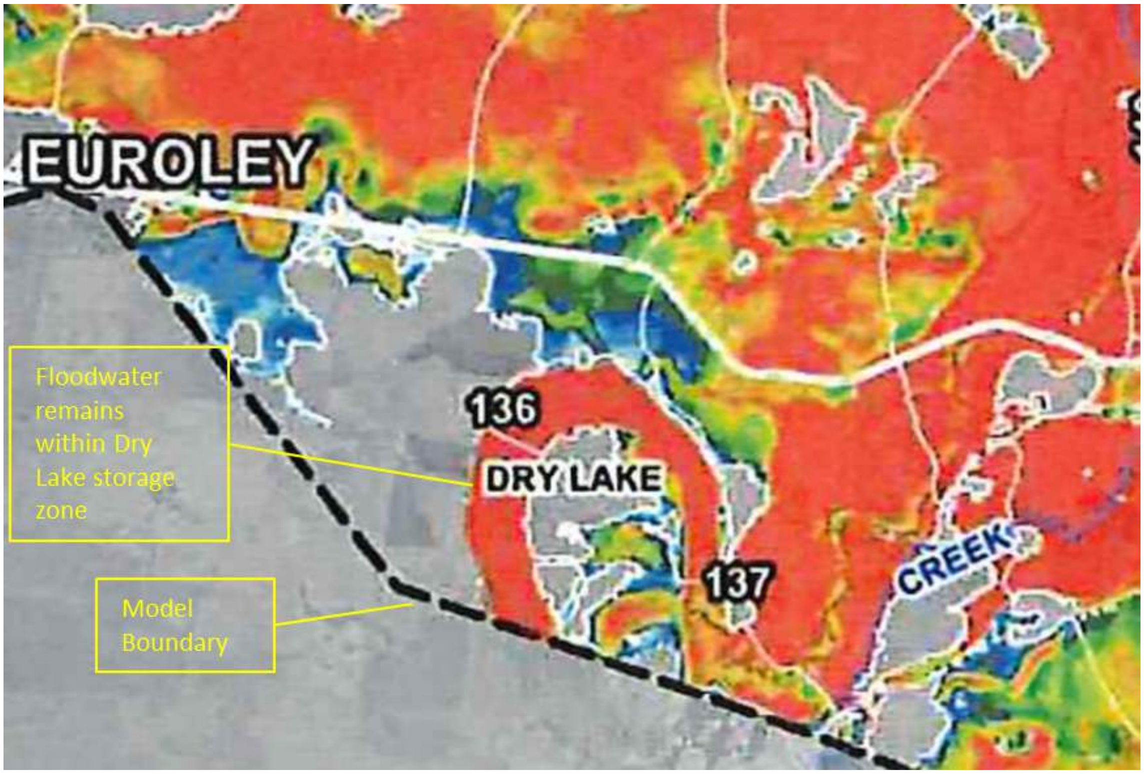
- Channel width – 1,600 m
- Flood depth – 0.1 to 0.2m
- Adopted Slope – 0.1%
- Rectangular channel
- No losses between model boundary and Site boundary

Flow rates were predicted to range between 1.8 and 5.8 m^3/s (for flood depths of 0.1 to 0.2 m respectively).

3.2 Yanco Creek floodplain at Dry Lake

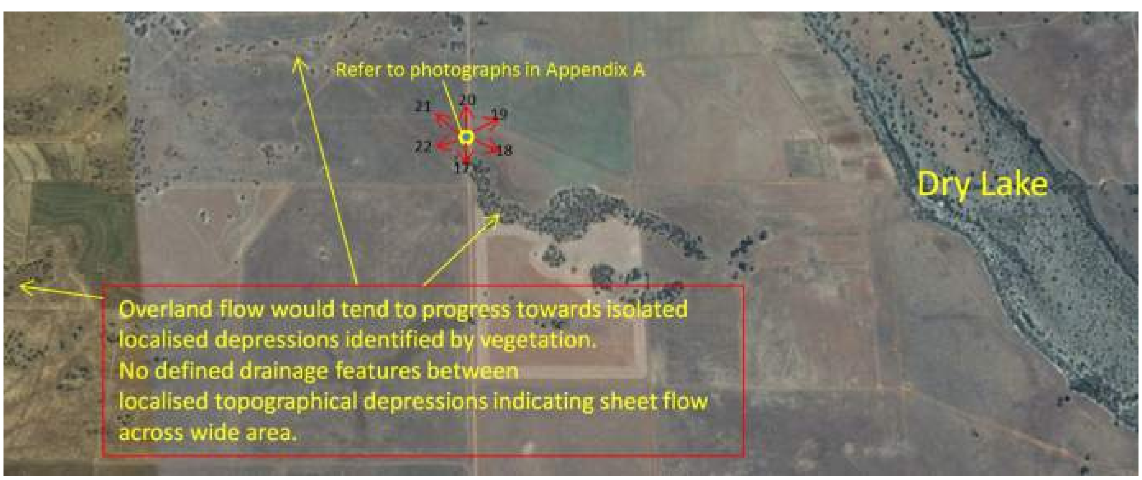
The PMF extent at Dry Lake is shown to remain within a defined flood storage zone up to the model boundary (Lyall & Associates, 2015) as shown in **Figure 2** below. The model boundary does not extend to the southern portion of Dry Lake. The potential for Dry Lake to overtop its banks in this southern area during a large to extreme flood event is considered below.

Figure 2 Potential flood risk associated with Yanco Creek PMF extent at Dry Lake



No flow paths were identified between Dry Lake and the Site during the Site walkover. The hydraulic grade between flood water in Dry Lake and the Site was estimated to be approximately 1 in 0.0004 (0.04%). Any floodwater that does overtop the Dry Lake area to the south of the model boundary would flow at a very low velocity towards topographical depressions within the fields extending approximately 4.3 km between Dry Lake and the Site as identified in **Figure 3** below. Floodwater from this zone is therefore not considered to pose a flood risk to the Site.

Figure 3 Local overland flow within proximity to Dry Lake



3.3 Conclusions

As the predicted PMF flow within the Euroley area (as detailed in Section **3.1**) was less than 1% of the predicted PMF local overland flood flow rate and less than 10% of the 100 year local overland flow rate (as detailed in Section **4.1.4**), it is considered that main stream flooding presents a secondary flood risk to the development. Due to the size of the Murrumbidgee catchment, the main stream PMF event will not coincide with the local overland flooding PMF event. Therefore measures to manage local overland flooding will safeguard the development from main stream flooding.

4 LOCAL OVERLAND FLOODING

Flood modelling including hydrological modelling and one dimensional (1D) hydraulic modelling was undertaken to assess flood levels across the Site in relation to overland flow via ephemeral flow paths which run through the site.

4.1 Hydrology

This component of the study was undertaken to determine the statistical flow rates (as peak flow rates) across the study areas in the 100 year and Probable Maximum Precipitation (PMP) Average Recurrence Interval design rainfall events.

In the absence of gauged flow data, theoretical statistical flow rates have been developed in accordance with procedures established in Australian Rainfall and Runoff (ARR) (Institute of Engineers, 1998).

4.1.1 Design Rainfall

Rainfall intensity, frequency and duration (IFD) parameters were obtained for the local area for the 100 year ARI from the Bureau of Meteorology website (BOM, 2015) which uses the techniques established in ARR.

The Generalised Short-Duration Method (BOM, 2003) was used to obtain the PMP rainfall depth for the critical 3 hour rainfall event. The PMP rainfall event was used to assess PMF event flood levels.

4.1.2 Hydrologic Model Development

The catchments were delineated by information collected during the Site walkover, topographic survey of the Site and aerial photography. The delineated sub catchments were applied within RORB.

The RORB hydrologic model was used to estimate the 100 year ARI and PMF peak flow rates. The RORB model is an interactive runoff routing and stream flow routing program that calculates the amount of rain that becomes stream flow during high intensity rain events (design storms).

Two main ephemeral flow paths were identified within the Site boundary. A RORB model for each ephemeral catchment was developed.

The sub catchments, nodes and channel types applied within the RORB model are presented schematically in **Figure 4** and **Figure 5** below.

As the proposed 1D hydraulic modelling approach does not account for lateral flows between ephemeral flow paths, a conservative hydrological modelling approach was adopted as follows:

- the Site was separated into two catchments accounting for the main two ephemeral flow paths which flow from east to west across the Site.

- A hydrological model was developed for each catchment (northern zone hydrological model and southern zone hydrological model).
- Flow from the higher elevated, northern ephemeral flow path is likely to overflow towards the southern ephemeral flow path during the 100 year ARI and PMF flood events when the northern ephemeral flow path overtops its storage area. As it is not possible to accurately account for this within a 1D hydraulic model, the southern zone hydrological model accounted for the southern ephemeral catchment as well as the contributing portion of the northern ephemeral catchment. This is considered to be highly conservative.
- The northern zone hydrological model only accounted for the northern ephemeral catchment.
- The modelled peak flow rates at the downstream end of the Site were applied to all cross sections in each of the hydraulic models (refer to Section **4.2**)

Figure 4 Hydrological model of southern ephemeral flow path catchment including contributing portion of northern ephemeral catchment overflows

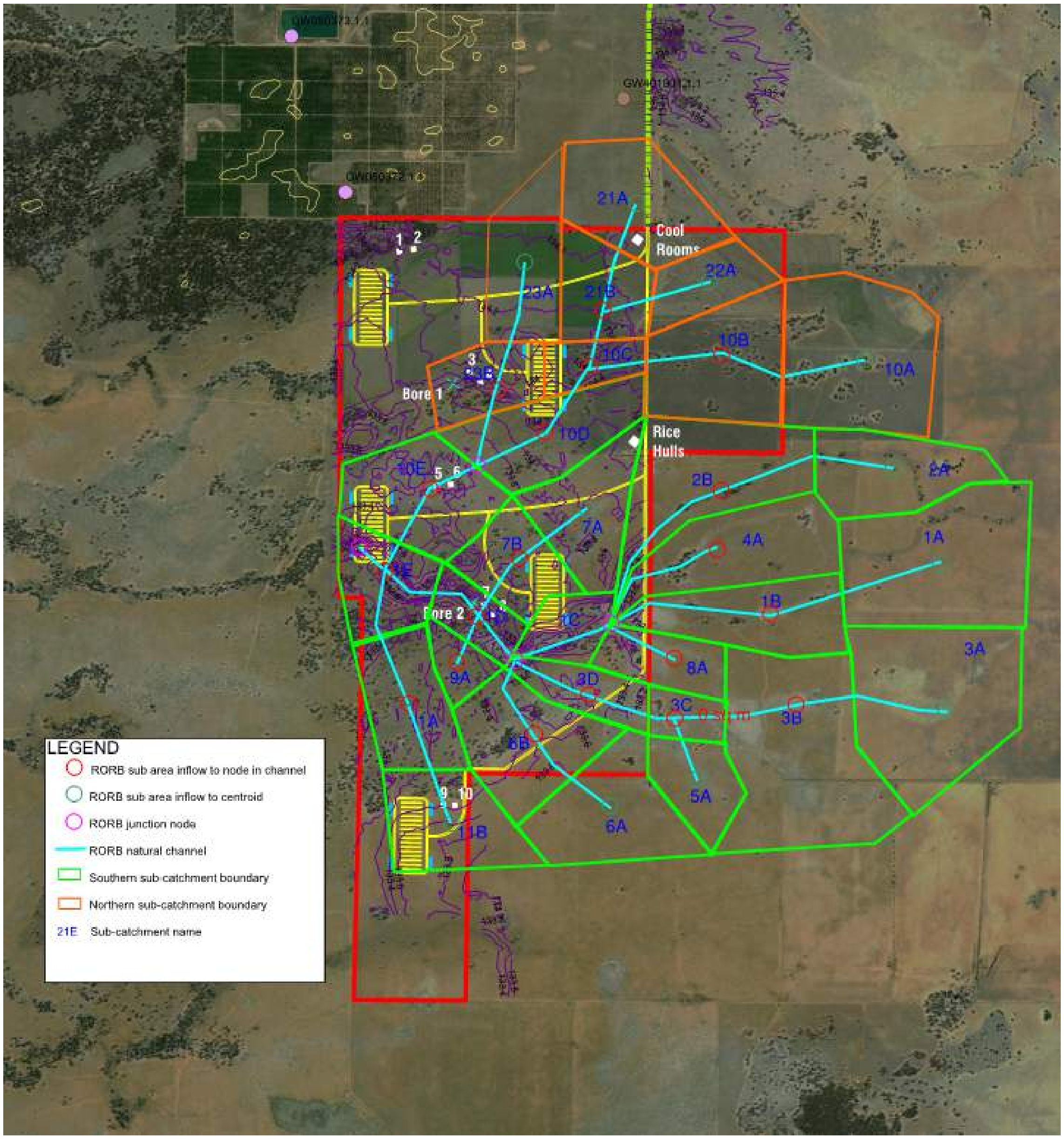
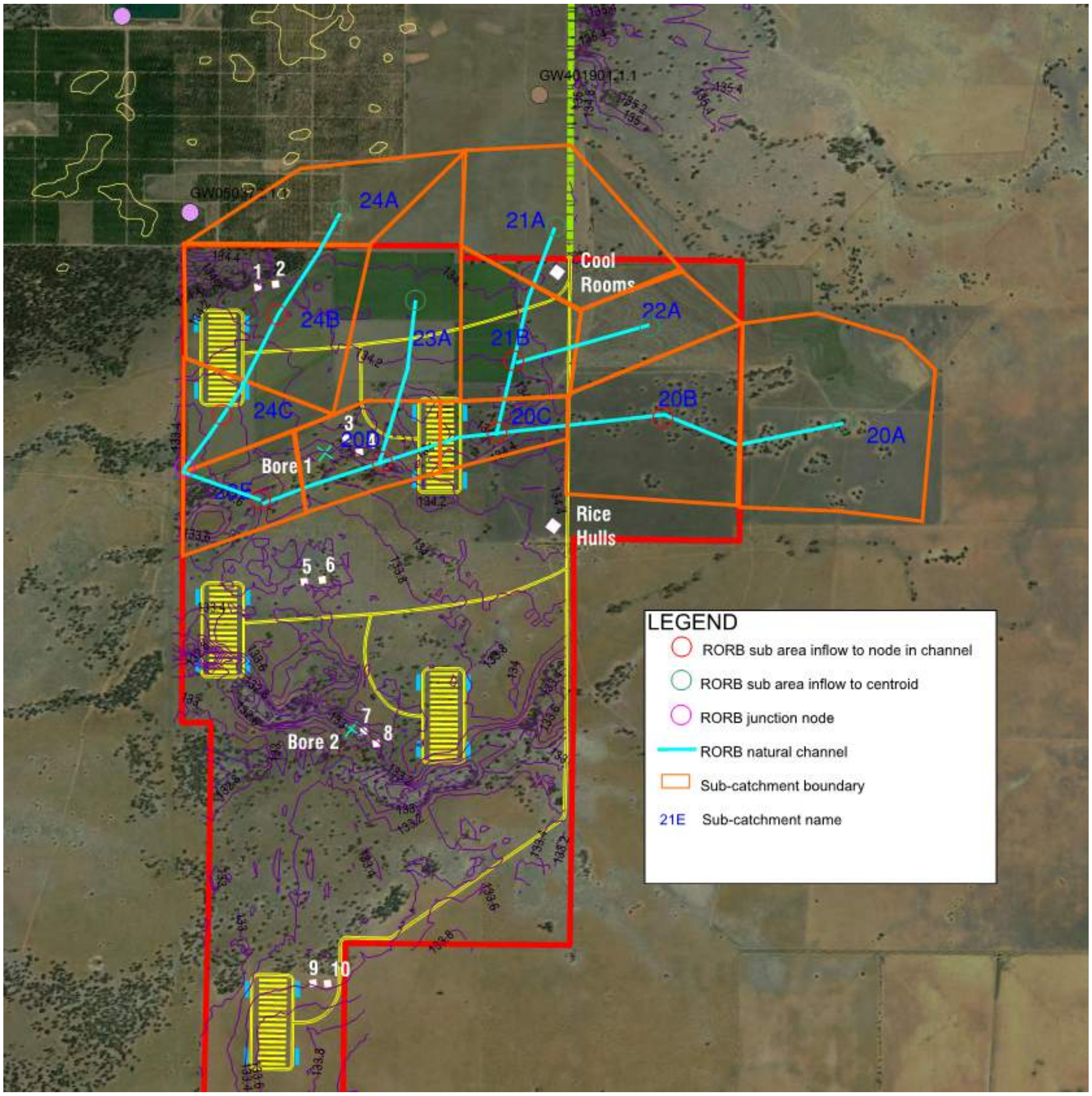


Figure 5 Hydrological model of northern ephemeral flow path catchment



4.1.3 Model parameters

Predicted flow rates are sensitive to the selection of correct parameters. As flow rates were unable to be calibrated, model assumptions, listed in **Table 1** below, were based on regional values and procedures documented in ARR.

Table 1 Model Parameters

Parameter	Value	Reference
IL – Initial Loss (mm)	100 year ARI and PMP - 15	From Table 3.2, Vol.1, Book II (ARR)
CL – Continuing Loss (mm/hr)	100 year ARI - 4 PMP - 1	From Table 3.2, Vol.1, Book II (ARR) and Section 4 of Book VI.
Kc – Channel Storage Parameter	4.85	Kc was calculated manually based on the method outlined in ARR for South-eastern Australia.
m – Non-linearity Parameter	0.8	From Section 3, Book V (ARR)

4.1.4 Peak flow rates

The peak flow rates at the downstream end of each hydrological model area detailed in **Table 2** below.

Table 2 Predicted peak flow rates

ARI	Southern Catchment Flow Rate (m3/s)	Northern Catchment Flow Rate (m3/s)
100 year	60.6	13.5
PMF	686	172

4.2 Hydraulic Model

A hydraulic model was developed for the Site. The site topography is presented in **Figure 6**.

Computer simulations of flooding within the Site were undertaken using HEC-RAS software. This 1D hydraulic modelling approach was adopted due to project constraints. The limitations of the 1D modelling are that it will tend to slightly overestimate flood levels within the main ephemeral flow path (running east to west) but slightly underestimate flood levels where low risk shallow lateral minor flows and sheet flow (from north to south) occurs between the main ephemeral flow paths.

A 2D modelling approach could alternatively be undertaken, which is likely to predict lower flood levels than the adopted 1D hydraulic modelling approach for key low lying floodable areas but provide a more accurate representation of minor lateral flow paths between the main ephemeral flow paths. The predicted flood levels developed as part of the 1D hydraulic modelling are therefore considered to be conservative and appropriate for setting building floor levels.

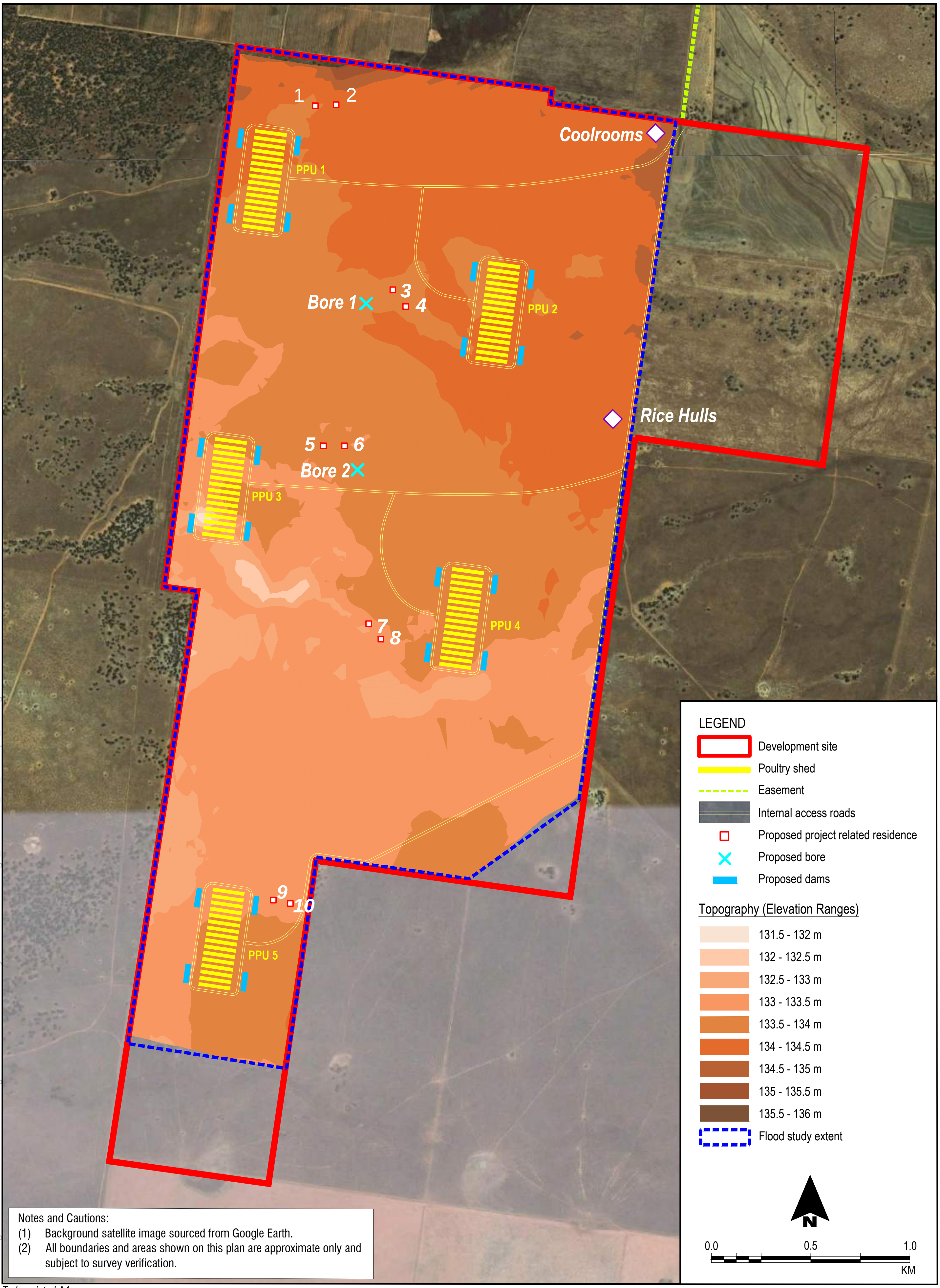
Two hydraulic models were developed, one to simulate the northern ephemeral flow path and one to simulate both the combined southern and northern ephemeral flow paths, with the worst case flood level for the northern ephemeral flow path selected. Cross sections at key locations were extracted from a digital terrain model based upon survey data provided by ProTen.

The modelled peak flow rates at the downstream end of the Site as detailed in **Table 2** were applied to all cross sections in each of the hydraulic models.

A roughness value of 0.04 was adopted for the entire Site.

A schematic of the two hydraulic models is outlined in **Figure 7**.

Figure 6 Site Topography



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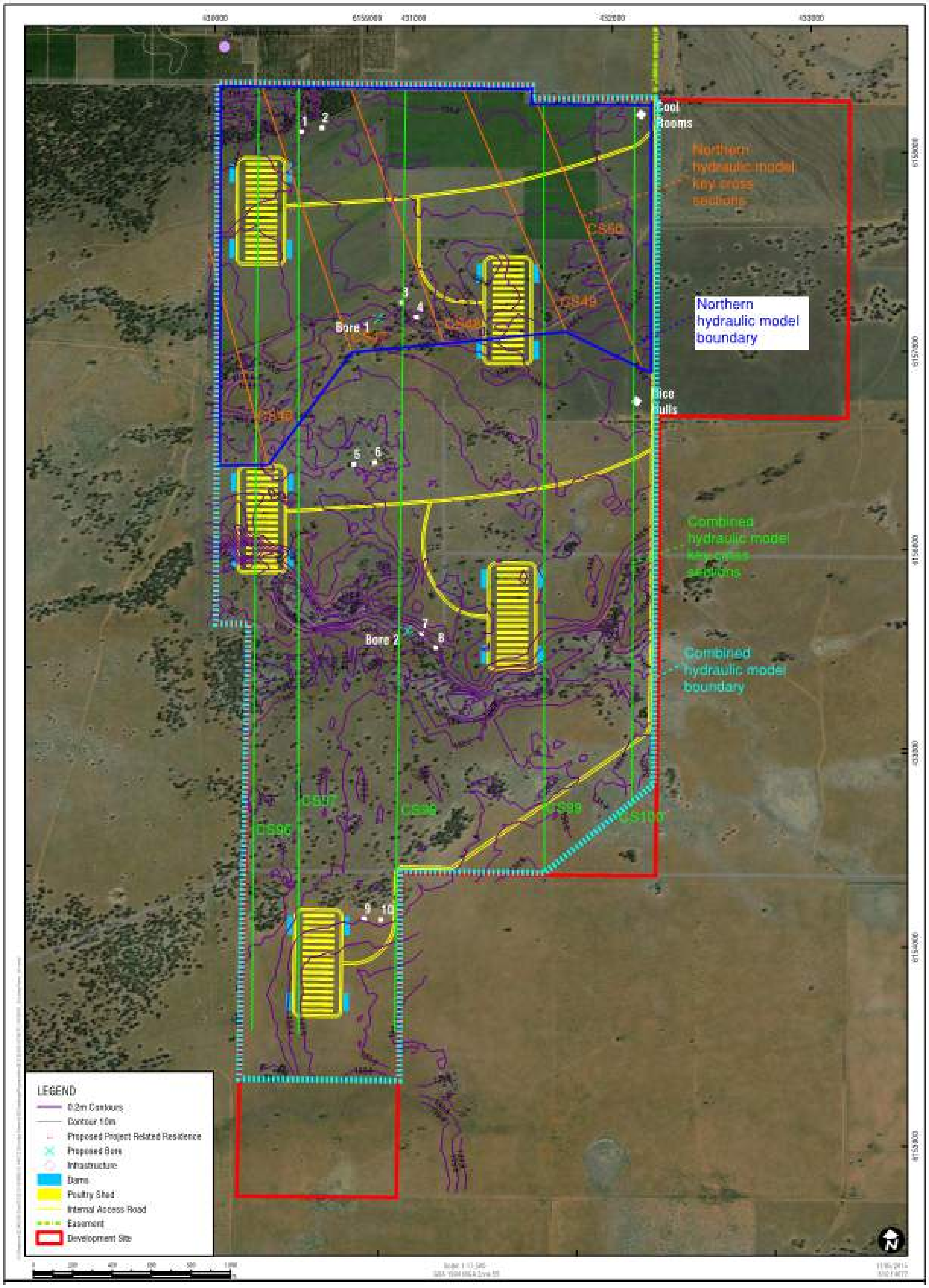
Site Topography

FIGURE 6

Figure 7 Key hydraulic model details



4.2.1 Calibration

The hydraulic models were un-calibrated as no historical flood levels were available across the Site.

4.3 Pre-development Flood Modelling Results

Flood Levels upstream of each farm building and at the key cross section locations are detailed in **Table 3** below. It is noted that flood levels relate to the ephemeral flow paths and do not account for localised shallow sheet flow which will be mitigated by the proposed design.

Flood mapping showing the flooding extent and flood depths for the 100 year ARI and PMF events in relation to the ephemeral flow paths is provided in **Figure 8** and **Figure 9**.

Table 3 Pre-development Flood Levels

Farm	Relevant Model	100 year ARI Flood Level (mAHD)	PMF ARI Flood Level (mAHD)
PPU1	Northern	134.00	134.34
PPU2	Northern	134.28	134.72
PPU3	Combined / North	133.13 – 133.63	133.73 - 134.09
PPU4	Combined	133.65	134.37
PPU5	Combined	133.27	133.87
Residence	**Relevant Model**	**100 year ARI Flood Level (mAHD)**	**PMF ARI Flood Level (mAHD)**
1	Northern	134.09	134.41
2	Northern	134.03	134.33
3	Northern	134.11	134.45
4	Northern	134.12	134.47
5	Combined	133.29	133.88
6	Combined	133.36	133.94
7	Combined	133.46	134.05
8	Combined	133.49	134.09
Cross Section	**Relevant Model**	**100 year ARI Flood Level (mAHD)**	**PMF ARI Flood Level (mAHD)**
50	Northern	134.34	134.79
49	Northern	134.28	134.72
48	Northern	134.16	134.55
47	Northern	134.00	134.34
46	Northern	133.63	134.09
100	Southern	133.73	134.56
99	Southern	133.65	134.37
98	Southern	133.45	134,01
97	Southern	133.18	133.76
96	Southern	133.08	133.65

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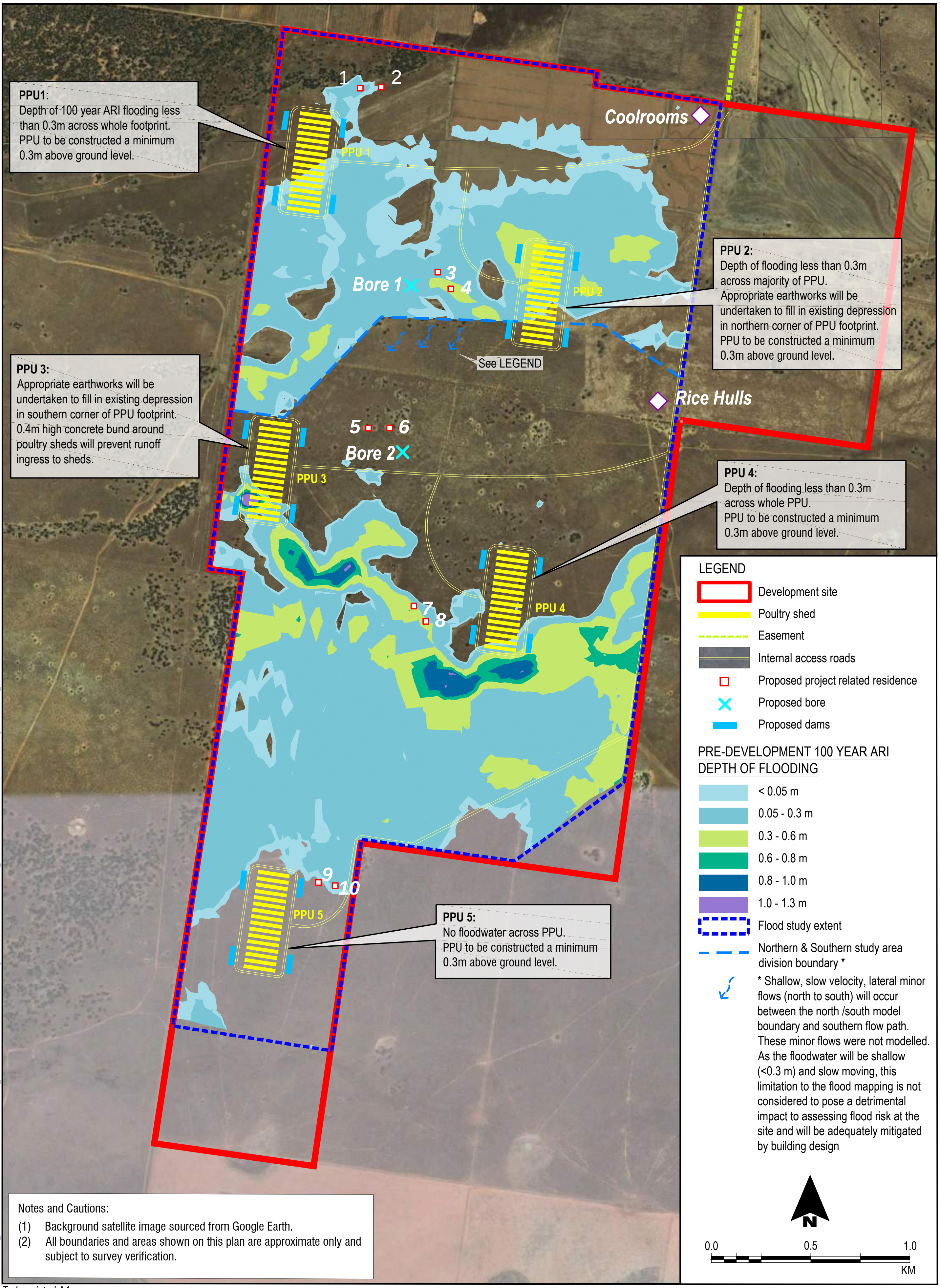
Figure 8 Pre-Development 100 year ARI Flood Extent



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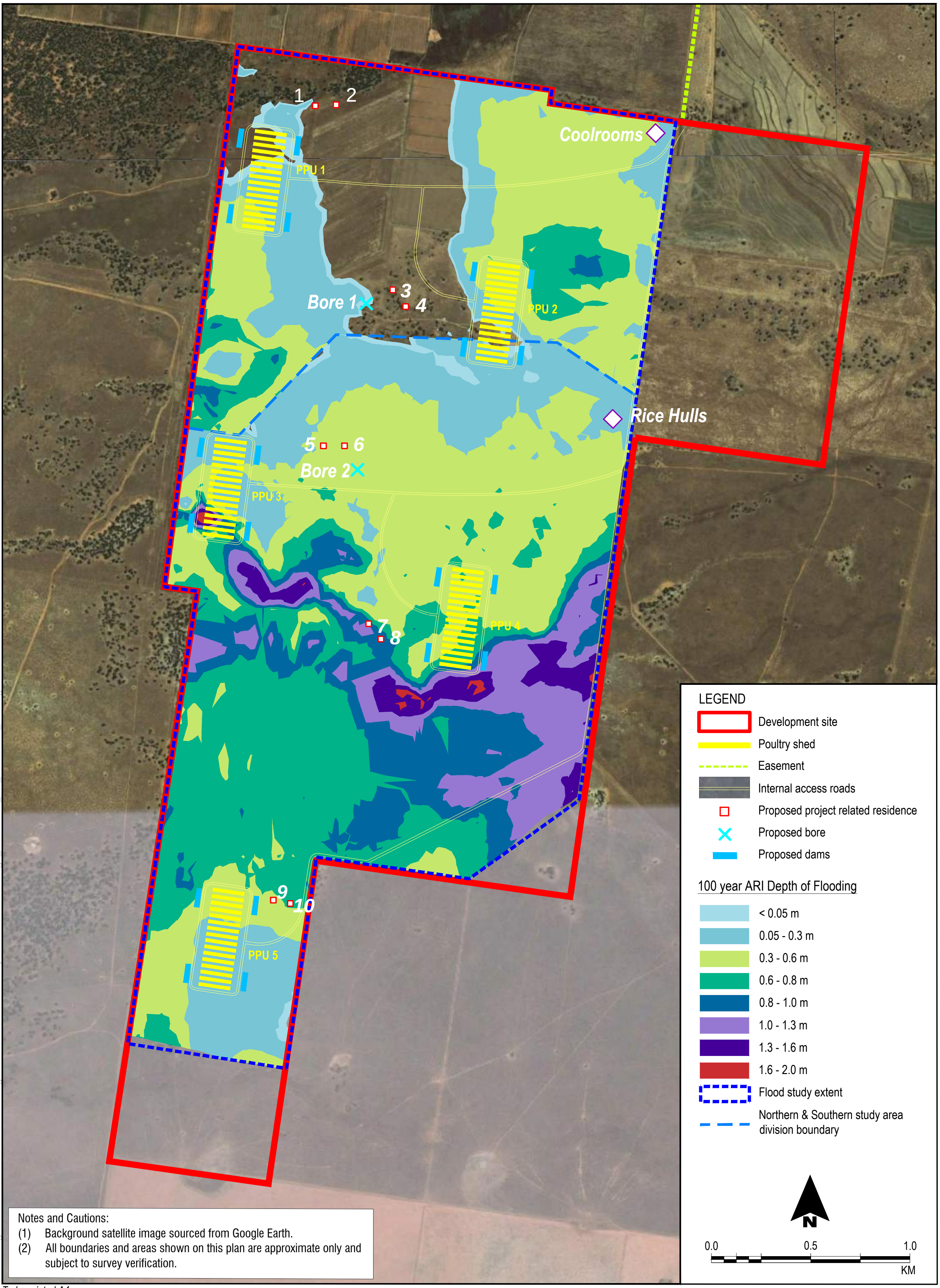
Pre-Development 100 Year ARI Flood Extent

FIGURE 8



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Pre-Development PMF Flood Extent

FIGURE 9

Figure 9 Pre-Development PMF Flood Extent

As discussed in Section **4.1.2**, the flood mapping is based upon 1D hydraulic modelling which does not accurately represent sheet and minor flow between the main flow paths. Therefore whilst flood levels are considered to be conservative at key locations, some shallow flooding not shown in the maps may occur in areas which are shown to be dry. As the floodwater will be shallow (<0.3 m) and slow moving, this limitation to the flood mapping is not considered to pose a detrimental impact to assessing flood risk at the site and will be adequately mitigated by appropriate design (i.e. 400mm high bund around poultry sheds).

4.4 Proposed development hydraulic impacts

A detailed hydraulic impact assessment has not been undertaken for the proposed development layout. However a preliminary model was developed which incorporated modifications to each hydraulic model to account for the existing farm building layout by raising cross section elevations within the proposed building locations.

The preliminary hydraulic impact modelling indicates that the 100 year ARI flood level will be raised by less than 150 mm locally upstream of the buildings and the PMF flood level will be raised by less than 300 mm locally upstream of the buildings. These modelled onsite flood afflux impacts are considered to be conservative. No flood afflux impacts were shown to occur downstream of the western buildings. Flood velocities generally decreased with the maximum velocity increase modelled to be 0.08 m/s.

There are no existing buildings or infrastructure on neighbouring properties that are likely to be affected by the construction of the proposed farm buildings or associated infilling earthworks.

5 REFERENCES

BOM, 2003, The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method, Commonwealth Bureau of Meteorology, 2003

CSIRO, Floodplain management in Australia: best practice principles and guidelines, 2000

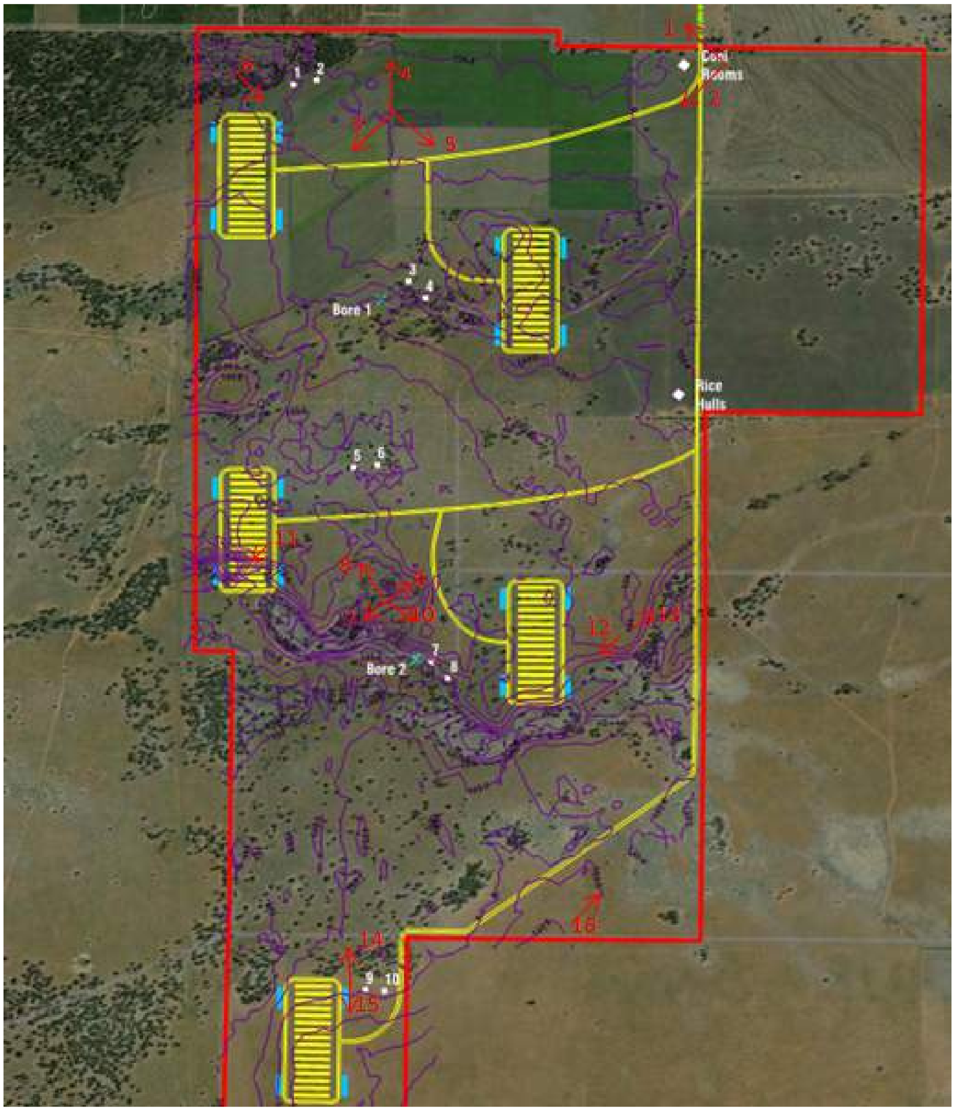
Department of Infrastructure, Planning and Natural Resources, Floodplain Development Manual, The management of flood liable land, April 2005

Institute of Engineers, 1998, Australian Rainfall and Runoff, Volume One – A guide to flood estimation, Reprinted Edition, 1998.

Flooding Site Walkover Photographs

Flooding Site Walkover Photographs

Photograph Location Plan



Flooding Site Walkover Photographs

Photograph 1

Photograph 2

Photograph 3

Photograph 4

Photograph 5

Photograph 6

Flooding Site Walkover Photographs

	
Photograph 7	Photograph 8
	
Photograph 9	Photograph 10
	
Photograph 11	Photograph 12

Flooding Site Walkover Photographs


Photograph 13


Photograph 14


Photograph 15


Photograph 16


Photograph 17


Photograph 18

Flooding Site Walkover Photographs

Photograph 19

Photograph 20

Photograph 21

Photograph 22